Transition from an Anomalous to a Normal Electrodeposition Mechanism of Zn-Co Alloys by the Effect of BA

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The electrodeposition of zinc with iron, nickel or cobalt is normally assumed as an anomalous deposition process because of the less noble metal (Zn) is deposited as the majoritary element (Zn content 80electrodeposited alloy. The hydroxide suppression model is the most accepted model to explain this fact: this model supposes that the zinc hydroxyde formed at the beginning of the electrodeposition process is adsorbed at the electrode surface, increasing, the zinc electrodeposition rate and inhibiting the electrodeposition of the alloying element. The limits of this model are not clear and the model does not explain, by example, the deposition from alkaline solutions either not the effect of specific adsorption at the electrode surface. In this sense, most of the additives used in electrodepositon baths can be adsorbed specifically at the electrode surface, modifying the deposition mechanism and the physical and chemical properties of the obtained deposits.

In this work the influence of bencylideneacetone (BA), as an additive, on the composition, morphology and nucleation mechanism of electrodeposited zinc-cobalt alloys is studied. An electrochemical study of the process was carried out for zinc, cobalt and zinc-cobalt solutions, by using CV, RDE, inversion potential and chronoamperometric techniques. The nucleation mechanism was analyzed by applying the dimensionless graph model for 3D instantaneous and progressive nucleation process to the obtained current time transients.

Results show that BA has a selective effect on cobalt electrodeposition, increasing the exchange current density (j0Co). This increase produces a change in the deposition mechanism of zinc-cobalt alloys from an anomalous to a normal deposition process. Also, BA modifies the nucleation mechanism from a two stages 3 D progressive nucleation mechanism to a single 3D progressive nucleation mechanism.

Auger spectroscopy was used to analyse the effect of BA on the distribution profile of the alloying elements as a function of the deposition conditions. A notorious decrease in the oxygen content is observed when BA is present in the deposition bath. This result indicates that, in the presence of BA, the contribution of zinc hydroxide is not critical in the alloy electrodeposition process and supports that the alloy deposition involves a normal deposition mechanism. Also, results show that BA allows to obtain a more homogeneous distribution of the alloying elements.

SEM analysis shows a change in the morphology of the deposits, associated to the presence of BA. The grain size is decreased when the BA concentration is increased in the deposition bath; In addition, the presence of BA allows to obtain compact and brightness deposits. This effect is well know for additives act as brightners in electrodeposition process.

From these results, it is possible to conclude that BA modifies the electrochemical parameters of the electrodeposition process of Co and Zn Co alloys. BA changes the electrodeposition mechanism of Zn Co alloy from an anomalous to a normal mechanism. BA acts as an brigthner and its presence in the deposition bath allows to obtain homogeneous, brightness deposits, with controlled composition.

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